Project Introduction

The innovation proposed is a plug-and-play module for NASA's proposed SMART NAS (Shadow Mode Assessment using Realistic Technologies for the NAS) system that computes and displays metrics related to how close to optimal a simulated scenario is performing under various system objectives in a multi-objective setting. The module, called TOMO (Toolkit for Optimization Metrics Overlay) is a large-scale optimization model that computes trajectories of aircraft under Trajectory Based Operations (TBO) that optimize system performance under various objectives such as delays, fuel burn, and environmental impacts. The toolkit is designed to be used either in shadow mode or in post-operations analysis. This capability within SMART NAS would allow a scenario's performance to be normalized against an achievable best case and will facilitate a meaningful comparison of the performance of scenarios with different types of demand, weather, and operating constraints. TOMO will also feature a "simultaneous playback" mode, in which a user can simultaneously compare the simulated scenario with an optimized version for each potential objective. TOMO is based on a new class of algorithms for solving large-scale TFM problems by separating TFM optimization into two problems---a master problem that checks for capacity violations and allocates resources to competing aircraft, and a sub-problem solved by each individual aircraft that generates 4-d trajectories for each flight. The master problem exchanges dual prices that signal congestion across ATC resources to guide the sub-problems to an optimal solution. This "agent-based" optimization approach is well-suited to be used within a large-scale agent-based simulation framework.

Primary U.S. Work Locations and Key Partners
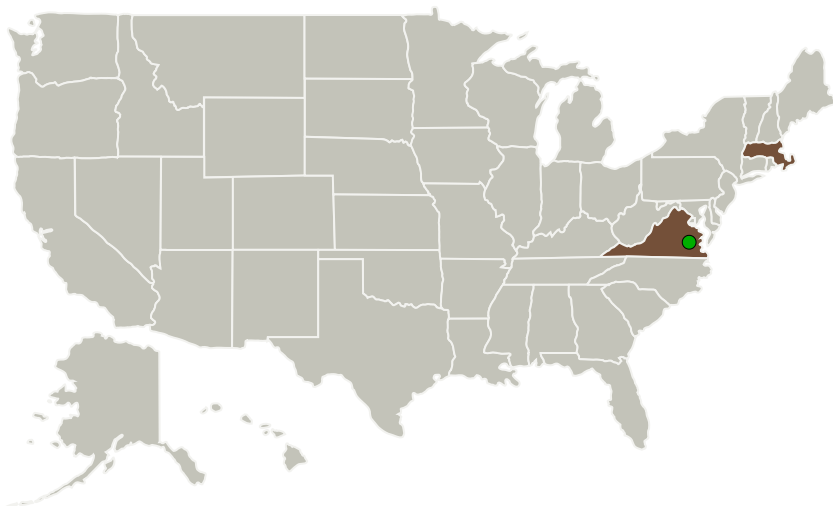

A SMART NAS Toolkit for Optimality Metrics Overlay, Phase I

Table of Contents

Organizations Performing Work	Role	Type	Location
Resilient Ops, Inc	Lead Organization	Industry	Winchester, Massachusetts
🟢 Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Massachusetts	Virginia

Project Transitions

▶ **June 2015:** Project Start
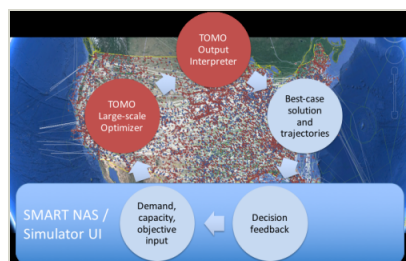
✔ **December 2015:** Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/138761)*
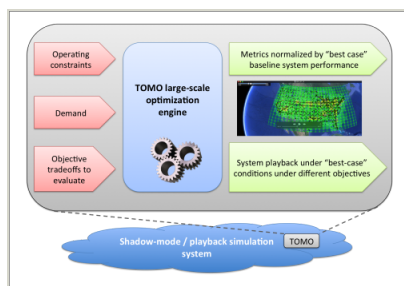
Images

Briefing Chart
A SMART NAS Toolkit for Optimality Metrics Overlay Briefing Chart
(https://techport.nasa.gov/image/129827)

Final Summary Chart Image
A SMART NAS Toolkit for Optimality Metrics Overlay, Phase I Project Image
(https://techport.nasa.gov/image/136057)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Resilient Ops, Inc

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management
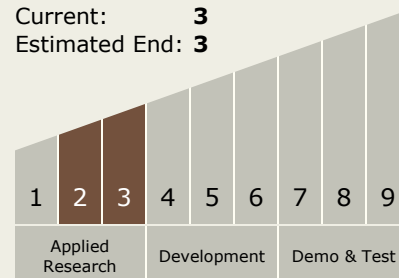
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Bala G Chandran

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**

1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

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For more information and an accessible alternative, please visit:
https://techport.nasa.gov/view/33441

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Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  └ TX11.3 Simulation
     └ TX11.3.5 Exascale Simulation

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System